TLE983x BSL Loader

Microcontroller Infineon Software Architecture

User's Manual

Released V1.0

2011-12

Microcontrollers

Edition 2011-12

Published by
Infineon Technologies AG
81726 Munich, Germany

© 2012 Infineon Technologies AG
All Rights Reserved.

LEGAL DISCLAIMER

THE INFORMATION GIVEN IN THIS DOCUMENT IS GIVEN AS A HINT FOR THE IMPLEMENTATION OF THE INFINEON TECHNOLOGIES COMPONENT ONLY AND SHALL NOT BE REGARDED AS ANY DESCRIPTION OR WARRANTY OF A CERTAIN FUNCTIONALITY, CONDITION OR QUALITY OF THE INFINEON TECHNOLOGIES COMPONENT. THE RECIPIENT OF THIS DOCUMENT MUST VERIFY ANY FUNCTION DESCRIBED HEREIN IN THE REAL APPLICATION. INFINEON TECHNOLOGIES HEREBY DISCLAIMS ANY AND ALL WARRANTIES AND LIABILITIES OF ANY KIND (INCLUDING WITHOUT LIMITATION WARRANTIES OF NON-INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS OF ANY THIRD PARTY) WITH RESPECT TO ANY AND ALL INFORMATION GIVEN IN THIS DOCUMENT.

Information

For further information on technology, delivery terms and conditions and prices, please contact the nearest Infineon Technologies Office (**www.infineon.com**).

Warnings

Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office.

Infineon Technologies components may be used in life-support devices or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.

Document Change History			
Date	**Version**	**Changed By**	**Change Description**
2010-06-01	0.1	Chandra	Initial
2011-05-24	0.2	Abdul Jaffar	Document sync with TLE983x_BSL_Loaderv0.3
2011-06-26	0.3	Abdul Jaffar	Document updated for OTP/100TP example and detail description on BSL modes
2012-01-13	1.0	Abdul Jaffar	-SM option updated in Command line options

We Listen to Your Comments

Is there any information in this document that you feel is wrong, unclear or missing?
Your feedback will help us to continuously improve the quality of this document.
Please send your proposal (including a reference to this document) to:

mcdocu.comments@infineon.com

Table of Contents **Page**

1 Introduction 8
1.1 Scope 8
1.2 Abbreviations 8
1.3 References 9

2 BSL Loader Overview 10
2.1 NAC Definition 10

3 Explanation of various BSL options for TLE983x 12
3.1 UART BSL Mode 12
3.1.1 Transfer Block Structure 12
3.1.2 Communicating via UART BSL Mode 12
3.2 Lin BSL Mode 13
3.2.1 Communicating via Lin BSL Mode 13
3.2.2 Automatic Synchronization to the Host 14
3.3 DAS Support 14
3.4 Hardware Connection between Host and Device 14
3.4.1 RS232 Transceiver Interface 14
3.4.2 USB UART Bridge Interface 15
3.4.3 LIN Transceiver Interface 15
3.4.4 USB Wiggler - DAP Interface 15
3.5 Possible BSL Modes 16
3.5.1 Procedure to execute “Mode A” requests 17
3.5.1.1 Read Device information - (Option 0x00) 17
3.5.1.2 Verify Flash Page using checksum - (Option 0x10) 17
3.5.1.3 Verify Entire Flash using checksum - (Option 0x18) 18
3.5.1.4 Verify Configuration Sector using checksum - (Option 0x50) 19
3.5.1.5 Flash Page Read - (Option 0xC0) 19
3.5.1.6 Configuration Sector Read - (Option 0xF0) 20
3.5.2 Available operation modes / corresponding BSL mode 21

4 User Interface Description 22
4.1 Description of Menu Items 23
4.1.1 File Menu 23
4.1.1.1 Open 23
4.1.2 Select Product 23
4.1.3 BSL Mode 23
4.1.3.1 Lin Mode 23
4.1.3.2 Type of Checksum 23
4.1.4 Transceiver Mode 23
4.1.5 Status Window 24
4.1.6 Clear Status Window 24
4.1.7 Status information save to file 24
4.2 BSL Mode Selection 24
4.2.1 Mode 0 / 2 / 8: Transfer a user program from the Host to XRAM 24
4.2.2 Execute a user program in the XRAM 25
4.2.3 Execute a user program in the NVM 25
4.2.4 Erase NVM memory 25
4.2.5 NVM Protection Mode enabling / disabling Scheme 26
4.2.6 Get Mode A Information 27
4.2.7 Flash Memory read 27
4.2.8 NAD 28
4.2.9 NAC 28
4.2.10 Write NAC and NAD to device 28
4.2.11 Port Settings 28
4.2.12 Status Bar 28
4.2.13 Connect to TLE983x 29
4.2.14 Execute Mode 29
4.3 Sample/Example User configuration: 29

Table of Contents **Page**

4.4 Download to or Read from OTP / 100TP CS Page....32
4.4.1 Creating OTP / 100TP hex file....32
4.4.2 Downloading OTP / 100TP CS page....33
4.4.3 Read OTP / 100TP CS page....34

5 Command Line Argument....35
5.1 Edit default.ini file....37
5.2 Commands....37
5.2.1 Option....38

6 Assumptions and Limitations....39

List of Figures **Page**

Figure 1 Transfer Block for UART BSL 12
Figure 2 Transfer Block for Lin BSL 13
Figure 3 RS232 Transceiver Interface 14
Figure 4 USB UART Bridge Interface 15
Figure 5 LIN Transceiver Interface 15
Figure 6 USB Wiggler - DAP Interface 16
Figure 7 Mode A- Option 0x0 command frame 17
Figure 8 Mode A- Option 0x10 command frame 18
Figure 9 Mode A- Option 0x18 command frame 18
Figure 10 Mode A- Option 0x50 command frame 19
Figure 11 Mode A- Option 0xC0 command frame 20
Figure 12 Mode A- Option 0xF0 command frame 20
Figure 13 TLE9832_BSL_Loader Main Screen 22
Figure 14 CS Byte values 25
Figure 15 CS page option 25
Figure 16 Flash Erase Dialog 26
Figure 17 Flash password protect window 27
Figure 18 Mode A options 27
Figure 19 Flash Memory Read 28
Figure 20 Loading Hex File 29
Figure 21 Selecting TLE9832 30
Figure 22 BSL Mode Selection [UART BSL selected] 30
Figure 23 Transceiver Modes 30
Figure 24 COM Port Settings 31
Figure 25 BSL Modes selection 31
Figure 26 BSL_Loader Main Page selection 36

List of Tables **Page**

Table 1 Supporting Devices 8
Table 2 Abbreviations used in this document 8
Table 3 NAC Specification 11
Table 4 Available operation modes / corresponding BSL mode 21
Table 5 NAD specification 28
Table 6 OTP / 100TP File Structure 32
Table 7 Sample OTP / 100TP File Structure 32

1 Introduction

This User Manual provides information regarding the functionality and usage of the TLE983x BSL Loader application.

This User Manual is intended to help the user to get acquainted with the TLE983x_BSL_Loader tool.

1.1 Scope

This document explains the TLE983x_BSL_Loader user interface and the means by which a user can execute various BSL commands using this tool. Information is provided in brief about the UART, LIN BSL & DAS Modes and their options. Any details of the BSL itself are not described in this document.

Table below described a list of supported device.

Table 1 Supporting Devices

Device	Flash Size
TLE9830	24K
TLE9831 & TLE9832	36K
TLE9835 & TLE9833	48K
TLE9834	64K

1.2 Abbreviations

The abbreviations used inside this document are explained in Table 2.

Table 2 Abbreviations used in this document

Abbreviation	**Explanation**
100TP	100-Time Programmable
BSL	BootStrap Loader
CS	Configuration Sectors
DAP	Device Access Port
DAS	Device Access Server
EOT	End of Transmission
LIN	Local Interconnect Network
NAC	No_Activity_Count
NAD	Lin Node Address
NVM	Non Volatile Memory
OTP	One-Time Programmable
UART	Universal Asynchronous Reception Transmission
SFR	Special Function Register
XRAM	Extended Random Access Memory
XSFR	Extended Special Function Register(s)

1.3 References

This section lists all relevant documents for this User Manual.

Refer to the latest version for the documents without version information.

[1] Specification of TLE983x BSL, TLE983x_BootROM_UM_V2.16.pdf, V2.16, December 2011

[2] LIN Specification Package documentation, Revision 2.0, 23rd September 2003

2 BSL Loader Overview

The Bootstrap loader software is a tool which is able to connect to the target's special program located in the BootROM in a convenient fashion. It provides a mean to communicate with the target, while providing an interface for the underlying BSL capacities. Its major use is to download code / data to XRAM / Flash memory and erase the underlying flash memory. Typical mode of communication is via UART protocol over the RS232 / Lin interface and DAS over DAP port.

In order to select appropriate BSL interface, user must define an 8 bit value, known as the NAC in user code. Entry to BSL modes is determined by the value defined as the NAC. Detailed description of NAC can be found in chapter 2.1, NAC definition.

TLE983x BSL executes user provided commands using a number of operating modes. They are described in brief as under and are available through all interfaces (i.e. UART, Lin and DAS). Detailed description of these modes of operation is found in chapter 3.5

Mode 0 (00_H): Transfers a user program from the Host to XRAM

Mode 1 (01_H): Executes a user program in the XRAM

Mode 2 (02_H): Transfers a user program from the Host to NVM (Flash)

Mode 3 (03_H): Executes a user program in the NVM

Mode 4 (04_H): Erases sector(s) in the NVM Memory. Number of Sectors is dependent upon flash size.

Mode 6 (06_H): Enables/disables the NVM Protection

Mode 8 (08_H): Transfers a user program from the Host to XRAM using the LIN checksum

Mode 9 (09_H): Executes a user program in the XRAM using the LIN checksum

Mode A ($0A_H$): Gets the Mode-A information (based on the option byte)

With the BSL loader application, all these modes of operation are provided to the user as a convenient GUI including a powerful yet simple command line interface to support different use cases.

2.1 NAC Definition

The entry to user mode / BSL Mode is determined by the NAC value which is defined in the user code. For the TLE983x devices with 36k NVM the NAC value is stored at the address 0x7FFC (linearly mapped NVM). The NAC value specifies the duration of delay before jumping to user mode measured from the reset release.

In order to let the firmware validate the NAC, a complement ($\overline{NAC}$) must also be stored.

The device will enter LIN BSL Mode if the NAC bit 7 is equal to zero and UART BSL Mode if it is equal to 1.

After ending the start up procedure, the program will detect any activities on the LIN bus / UART for a period of time, determined by (((NAC & 0x7F) - 0x01) * 5) ms reduced by the time already spent to perform the start up procedure.

When nothing is detected on the LIN bus / UART and (((NAC & 0x7F) - 0x01) * 5) ms is passed from reset going low, the device will jump to User Mode.

Anyhow, if NAC is 0x01 or 0x81, user Mode is entered immediately.

Table 3 provides an overview of valid NAC values and their meanings.

Note: NAC Address Location = Flash size – 4k – 4 byte.

$\overline{NAC}$ *Address Location = Flash size – 4k – 3 byte.*

If both values mismatch, then NAC is considered as Invalid.

Table 3 NAC Specification

NAC Value	Action
01_H, 81_H	0 ms delay. Jump to User Mode immediately
02_H, 82_H	5 ms delay before jumping to User Mode
03_H, 83_H	10 ms delay before jumping to User Mode
04_H, 84_H	15 ms delay before jumping to User Mode
05_H, 85_H	20 ms delay before jumping to User Mode
06_H, 86_H	25 ms delay before jumping to User Mode
07_H, 87_H	30 ms delay before jumping to User Mode
08_H, 88_H	35 ms delay before jumping to User Mode
09_H, 89_H	40 ms delay before jumping to User Mode
$0A_H$, $8A_H$	45 ms delay before jumping to User Mode
$0B_H$, $8B_H$	50 ms delay before jumping to User Mode
$0C_H$, $8C_H$	55 ms delay before jumping to User Mode
$0D_H$ - $7F_H$, 00_H, Invalid	Wait forever for the first LIN frame
$8D_H$ - FF_H, 80_H	Wait forever for the first UART frame

3 Explanation of various BSL options for TLE983x

This section provides brief information about the LIN, UART BSL and DAS interfaces for TLE983x and how BSL tool connect to the device.

3.1 UART BSL Mode

The communication between the Host and the UART BSL routine is done by a simple transfer protocol. The information is sent from the host to the device in blocks following a specified block structure. The communication is nearly unidirectional, that is, because the Host sends several transfer blocks and the UART BSL routines just confirms them by sending back an acknowledgement or error bytes.

3.1.1 Transfer Block Structure

A transfer block consists of three parts as described below:

Block Type: The type of block, which determines how the data in the data area are interpreted. Implemented block types are:

- 00_H type “HEADER”
- 01_H type “DATA”
- 02_H type “END OF TRANSMISSION” (EOT)

Data Area: A list of bytes, which represents the data of the block. The length of the data area cannot exceed 128 bytes for Mode 0 and 2. For Mode 2, the length of the data area is 128 bytes for NVM. This is due to NVM is written by a page each time.

Checksum: The XOR checksum of the block type and data area.

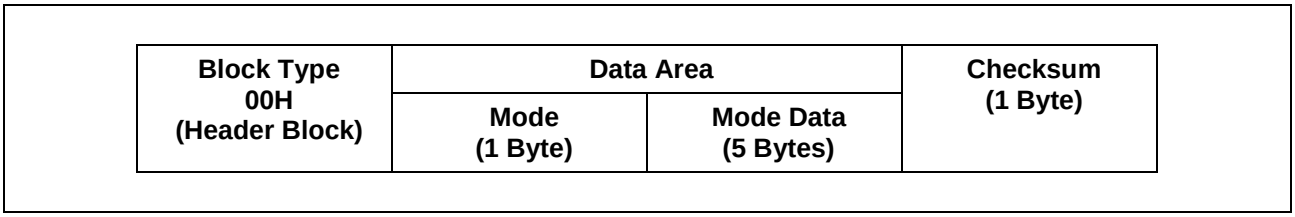

Figure 1 Transfer Block for UART BSL

3.1.2 Communicating via UART BSL Mode

The UART BSL Mode consists of two functional parts that present two phases as described below:

Phase I: Establish a serial connection and automatically synchronize to the transfer speed (baud rate) of the serial communication partner (Host).

Upon entering UART BSL Mode, a serial connection is established and the transfer speed (baud rate) of the serial communication partner (Host) is automatically synchronized in the following steps:

STEP 1: Initialize serial interface for reception and timer for baud rate measurement

STEP 2: Wait for test byte (80_H) from Host

STEP 3: Synchronize the baud rate to the Host

STEP 4: Send Acknowledge byte (55_H) to the Host

STEP 5: Enter Phase II

Phase II: After the successful synchronization to the Host, the UART BSL routine enters Phase II, during which it communicates with the Host to select the desired working modes. The Host controls the communication by sending special header information which selects one of the working modes.

3.2 Lin BSL Mode

The Standard LIN protocol can support baud rates of up to a maximum of 20 kBaud. FastLIN BSL protocol is an enhanced feature in the TLE983x device. This is introduced to support baud rates of 20 kBaud to 57.6 kBaud and 115.2 kBaud via a single-wire UART using the UART BSL protocol. Refer [1]

The LIN Mode supports LIN version 2.0 (Refer [2]).

Once successful synchronization to the Host is completed (with a Master Request Header), the LIN routine enters Phase II. Here, the Host communicates to the device in the desired working modes.

A simple transfer protocol is defined for the communication between the Host and device. The protocol data is performed in information blocks. The information block follows a specified block structure and is termed Transfer Block. Each transfer block is fixed at a length of 9 bytes. A transfer block consists of the following four parts:

- **NAD**: Node Address for Diagnostic specifies the address of the active slave node.
- **Block Type**: This field determines the data area.
- **Data Area**: This is the data of the block. The length is fixed at 6 bytes.
- **Checksum**: This checksum is calculated based on the NAD, Block Type and Data Area.

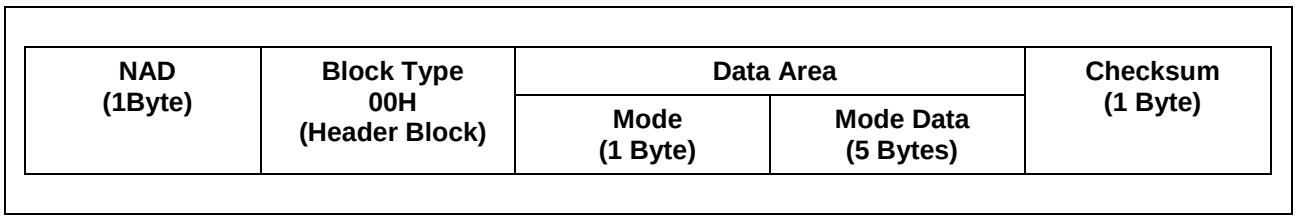

Figure 2 Transfer Block for Lin BSL

3.2.1 Communicating via Lin BSL Mode

The LIN BSL Mode consists of three functional phases described below:

Phase I: Establish a connection with every LIN frame (Master Request or Slave Response LIN frame) received by automatically synchronizing to the transfer speed (baud rate) of the communication partner (Host).

Phase II: Execute the Host specified command. In order to execute the commands, the Host needs to send a Master Request Header first, followed by a LIN Command. The selected mode information is embedded in the LIN Command.

Phase III: Send the device status to the Host. In order to receive the device status, the Host needs to send a Slave Response Header first.

Re-synchronization and setup of the baud rate (Phase I) are done at all times (before Phases II and III). Thus, different baud rates can be supported. Phase II is entered when it's Master Request Header is received, otherwise Phase III is entered (Slave Response Header). The Master Request Header has a Protected ID of 3CH while the Slave Response Header has a Protected ID of 7DH. The Command and Response LIN frames are identified as Diagnostic LIN frame with an eight data byte structure.

3.2.2 Automatic Synchronization to the Host

Upon entry to LIN Mode, a connection is established. The transfer speed (baud rate) of the serial communication partner (Host) is automatically synchronized in the following steps:

STEP 1: Initialize interface for reception and timer for the baud rate measurement

STEP 2: Wait for an incoming LIN frame from the Host

STEP 3: Synchronize the baud rate to the Host

STEP 4: Enter Phase II (for Master Request Frame) or

STEP 5: Phase III (for Slave Response Frame)

3.3 DAS Support

DAS supports communication to TLE983x via JTAG using DAP protocol. DAP uses a simple half-duplex protocol with two pins. Pin DAP0 is used as a reference clock, while DAP1 is used to transfer data between tool and device.

3.4 Hardware Connection between Host and Device

This section highlights common hardware connections between Host and device.

Diagrams provided in sections below display the interconnection between Host and device via a direct connection or an intermediate interface. These diagrams illustrate mainly the TXD and the RXD connection.

3.4.1 RS232 Transceiver Interface

Protocol: UART
Physical Interface: Full Duplex, Connected via a standard RS232 Cable / USB to UART connecter

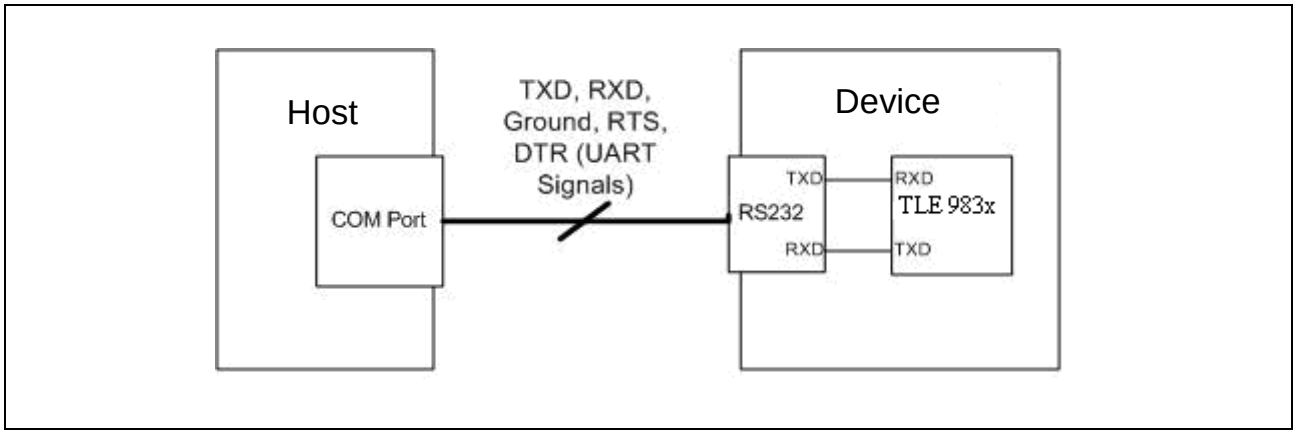

Figure 3 RS232 Transceiver Interface

3.4.2 USB UART Bridge Interface

Protocol: UART
Physical Interface: Full Duplex

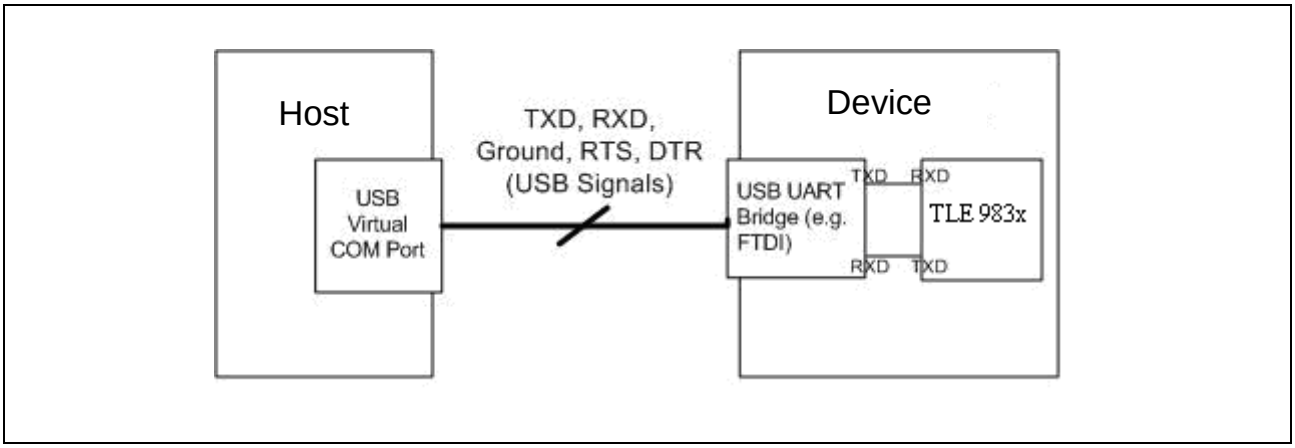

Figure 4 USB UART Bridge Interface

3.4.3 LIN Transceiver Interface

Protocol: Normal LIN / Fast LIN
Physical Interface: Half Duplex/Ignore Echo

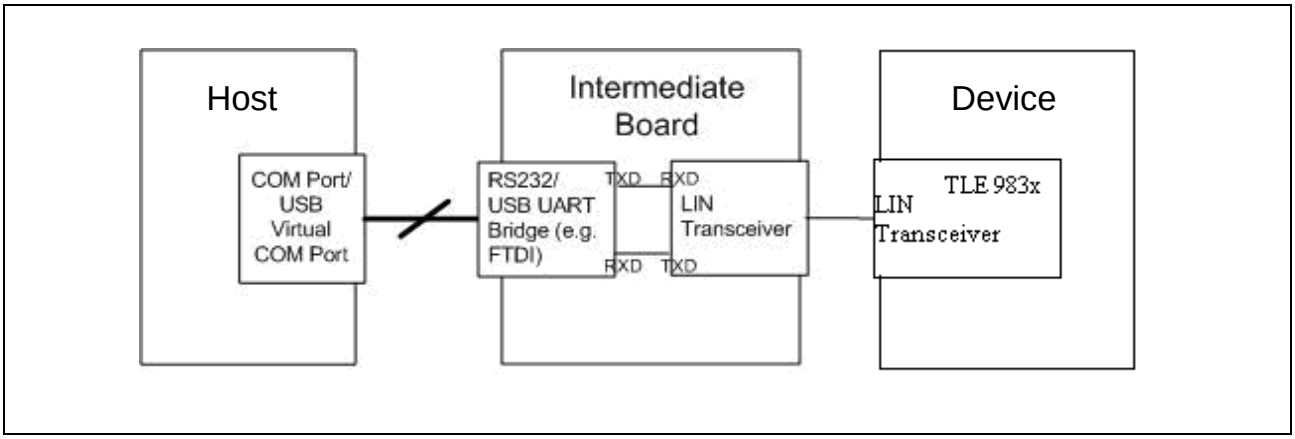

Figure 5 LIN Transceiver Interface

3.4.4 USB Wiggler - DAP Interface

Protocol: UDAS
Physical Interface: UDAS over DAP port

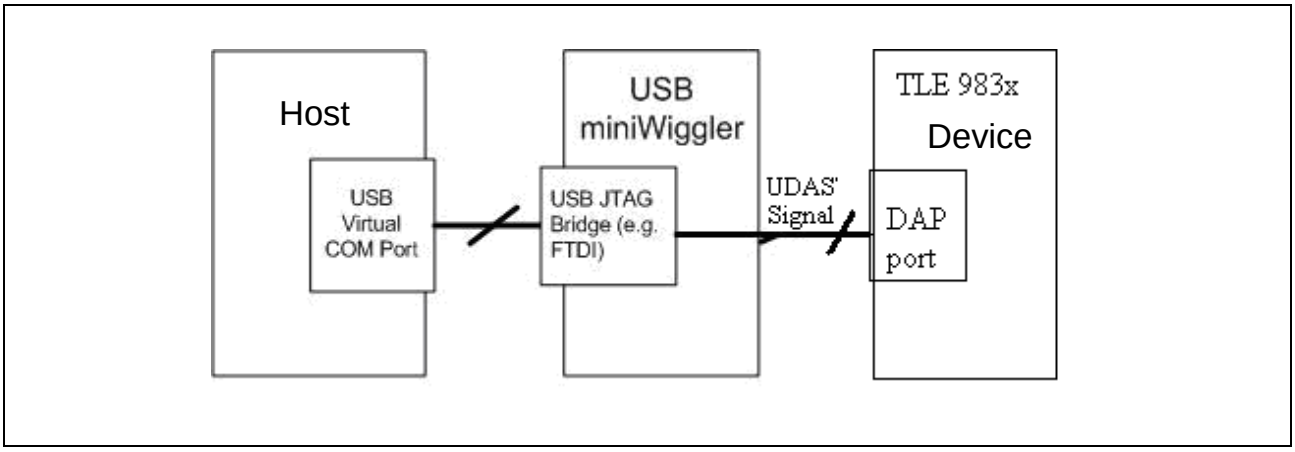

Figure 6 USB Wiggler - DAP Interface

3.5 Possible BSL Modes

This section provides necessary details about the BSL modes provided by TLE983x.

Mode 0 (00_H): Transfers a user program from the Host to XRAM.

Mode 0 is used to transfer a user program from the Host to the XRAM of the device via serial interface. If NVM protection is installed, programming to XRAM is not allowed.

The information sent to the device in Mode 0 is as follows:

Start Addr High, Low: 16-bit start address, which determines the location to copy the received data.

Block_Length: The length of the following Data Blocks or EOT Block.

Mode 1 (01_H): Executes a user program in the XRAM.

Mode 1 is used to execute a user program in the XRAM of the device at 0xF000.

In Mode 1, Header Block is the only transfer block to be sent by the Host, no further serial communication is necessary. The device will exit the UART/LIN BSL Mode and will jump to the XRAM address at 0xF000.

Mode 2 (02_H): Transfers a user program from the Host to NVM.

Mode 2 is used to transfer a user program from Host to the NVM of the device via serial interface.

Note: This mode is not accessible if NVM protection is installed.

Mode 3 (03_H): Executes a user program in the NVM.

Mode 3 is used to execute a user program in the NVM of the device at 0x0000.

Mode 4 (04_H): Erases sector(s) 1 to 9 in the NVM Memory.

Mode 4 is used to erase different sectors of the NVM. It supports mass erase of entire NVM, and individual erase for linear area or for non-linear area. This is determined by the option byte, which is selectable using a checkbox provided in the tool UI.

Note: This mode is not accessible if the NVM protection is installed.

Mode 6 (06_H): Enables/disables the NVM Protection.

Mode 6 is used to enable or disable the NVM Protection by a password. User defined password is passed in the Header Frame and the byte is given by the user to enable or disable the NVM Protection.

Mode 8 (08_H): Transfers a user program from the Host to XRAM using the LIN checksum (Inverse).

Mode 9 (09_H): Executes a user program in the XRAM using the LIN checksum (Inverse).

Mode A ($0A_H$): Gets the Mode-A information (based on the option byte).

Mode A is used to get distinct information from the device. This mode requires additional data to be sent to the device to distinguish between different requests. The requests supported by Mode A are described below:

1. Read Device information
2. Verify Flash Page using checksum
3. Verify entire Flash Pages using checksum
4. Verify Configuration Sector using checksum
5. Flash Page Read
6. Config Sector Read

3.5.1 Procedure to execute “Mode A” requests

3.5.1.1 Read Device information - (Option 0x00)

If the option value 0x00 is provided to the device, upon successful reception, the device will return an acknowledgement followed by 4 bytes of data.

The order of the 4 bytes of data is: SFR ID, CHIP_ID2, CHIP_ID1 and CHIP_ID0.

If an invalid option is received, the device will return 4 bytes with value 0x00.

Mode A, Option 0x00 command:

<table>
<tr><td rowspan="2">00H
(Header Block)</td><td rowspan="2">0AH
(Mode A)</td><td colspan="2">Data Area (5 bytes)</td><td rowspan="2">Checksum
(1 Byte)</td></tr>
<tr><td>Not Used
(4 Bytes)</td><td>Option
(1 Byte)</td></tr>
</table>

Figure 7 Mode A- Option 0x0 command frame

3.5.1.2 Verify Flash Page using checksum - (Option 0x10)

If the option value 0x10 is selected, the user has to provide additional 4 bytes of data to the device.

- First byte : Higher byte of Flash page start address
- Second byte : Lower byte of Flash page start address
- Third byte : Higher byte of expected checksum of the corresponding Flash page
- Fourth byte : Lower byte of expected checksum of the corresponding Flash page

The device will return an acknowledgement (0x55) followed by 4 bytes of data to the Host if the device has received a valid header frame.

The order of received 4 bytes is:

- Error indication (0x00 if successful else 0x80)
- Higher byte of actual flash checksum
- Lower byte of actual flash checksum
- Last byte is a dummy value (0x00)

If an invalid option is received, the device will return a Block fault (0xFF).

Mode A, Option 0x10 command:

00H (Header Block)	**0AH** (Mode A)	**Data Area** (5 bytes)					**Checksum** (1 Byte)
		Start Addr High (1 Byte)	**Start Addr Low** (1 Byte)	**Exp. CHKS High** (1 Byte)	**Exp. CHKS Low** (1 Byte)	**Option** (1 Byte)	

Figure 8 Mode A- Option 0x10 command frame

3.5.1.3 Verify Entire Flash using checksum - (Option 0x18)

If the option value 0x18 is selected, the user has to provide additional 4 bytes of data to the device.

- First byte : Not used
- Second byte : Not used
- Third byte : Higher byte of expected checksum of the entire Flash
- Fourth byte : Lower byte of expected checksum of the entire Flash

The device will return an acknowledgement (0x55) followed by 4 bytes of data to the Host if the device has received a valid header frame.

The order of the 4 bytes is:

- Error indication (0x00 if successful else 0x80)
- Higher byte of actual flash checksum
- Lower byte of actual flash checksum
- Last byte is a dummy value (0x00).

If an invalid option is received, the device will return a Block fault (0xFF).

Mode A, Option 0x18 command:

00H (Header Block)	**0AH** (Mode A)	**Data Area** (5 bytes)					**Checksum** (1 Byte)
		Not Used (1 Byte)	**Not Used** (1 Byte)	**Exp. CHKS High** (1 Byte)	**Exp. CHKS Low** (1 Byte)	**Option** (1 Byte)	

Figure 9 Mode A- Option 0x18 command frame

3.5.1.4 Verify Configuration Sector using checksum - (Option 0x50)

If the option value 0x50 is selected, the user has to provide additional 4 bytes of data to the device.

- First byte : CS byte (CS byte is used to address the target CS page).
  - Upper nibble: it indicates if an OTP or 100TP page is targeted
  - Lower nibble: it indicates which of the 4 possible pages is targeted
- Second byte : Not used
- Third byte : Higher byte of expected checksum
- Fourth byte : Lower byte of expected checksum

The device will return an acknowledgement (0x55) followed by 4 bytes of data to the Host if the device has received a valid header frame.

The order of the 4 bytes is:

- Error indication (0x00 if successful else 0x80)
- Higher byte of actual flash checksum
- Lower byte of actual flash checksum
- Last byte is a dummy value (0x00).

If an invalid option is received, the device will return a Block fault (0xFF).

Mode A, Option 0x50 command:

00H (Header Block)	**0AH** (Mode A)	**Data Area** (5 bytes)					**Checksum** (1 Byte)
		CS Page (1 Byte)	**Not Used** (1 Byte)	**Exp. CHKS High** (1 Byte)	**Exp. CHKS Low** (1 Byte)	**Option** (1 Byte)	

Figure 10 Mode A- Option 0x50 command frame

3.5.1.5 Flash Page Read - (Option 0xC0)

If the option value 0xC0 is selected, the user has to provide additional 4 bytes of information to the device.

- First byte : Higher byte of Flash page start address
- Second byte : Lower byte of Flash page start address
- Third byte : Not used
- Fourth byte : Not used

The device will return an acknowledgement (0x55) followed by 128 bytes of flash page data to the Host if the device has received a valid header frame.

If an invalid option is received, the device will return a Block fault (0xFF).

Mode A, Option 0xC0 command:

00H (Header Block)	**0AH** (Mode A)	**Data Area** (5 bytes)				**Checksum** (1 Byte)
		Start Addr High (1 Byte)	**Start Addr Low** (1 Byte)	**Not Used** (2 Bytes)	**Option** (1 Byte)	

Figure 11 Mode A- Option 0xC0 command frame

3.5.1.6 Configuration Sector Read - (Option 0xF0)

If the option value 0xF0 is selected, the user has to provide the CS byte information to the device.

- First byte : Not used
- Second byte : Not used
- Third byte : Not used
- Fourth byte : CS byte (CS byte is used to address the target CS page)
  - Upper nibble: it indicates if an OTP or 100TP page is targeted
  - Lower nibble: it indicates which of the 4 possible pages is targeted

The device will return an acknowledgement (0x55) followed by 128 bytes of configuration sector data to the Host upon receiving valid header information.

If an invalid option is received, the device will return a Block fault (0xFF).

Mode A, Option 0xF0 command:

00H (Header Block)	**0AH** (Mode A)	**Data Area** (5 bytes)			**Checksum** (1 Byte)
		Not Used (3 Bytes)	**CS Page** (1 Byte)	**Option** (1 Byte)	

Figure 12 Mode A- Option 0xF0 command frame

3.5.2 Available operation modes / corresponding BSL mode

Table 4 Available operation modes / corresponding BSL mode

Modes	UART	Normal LIN	Fast LIN	DAS
Flash user Code Execution (Mode 3)	Available	Available	Available	Available
XRAM user Code Execution (Mode 1)	Available	Available	Available	Unavailable
XRAM user Code Execution (Mode 9)	Unavailable	Available	Unavailable	Unavailable
Flash Erase –Erase Full chip, Sector Erase & Page Erase (Mode 4)	Available	Available	Available	Available (Except Page Erase)
Flash protect\unprotect (Mode 6)	Available	Available	Available	Unavailable
Flash download (Mode 2)	Available	Available	Available	Available
XRAM download (Mode 0)	Available	Available	Available	Unavailable
XRAM download (Mode 8)	Unavailable	Available	Unavailable	Unavailable
CS page download (Mode 0 – $0xF0_H$)	Available	Unavailable	Available	Unavailable
Mode A information (Mode A)	Available	Available (Except Flash & configuration sector Read)	Available	Unavailable

4 User Interface Description

The following section provides information about the user interface.

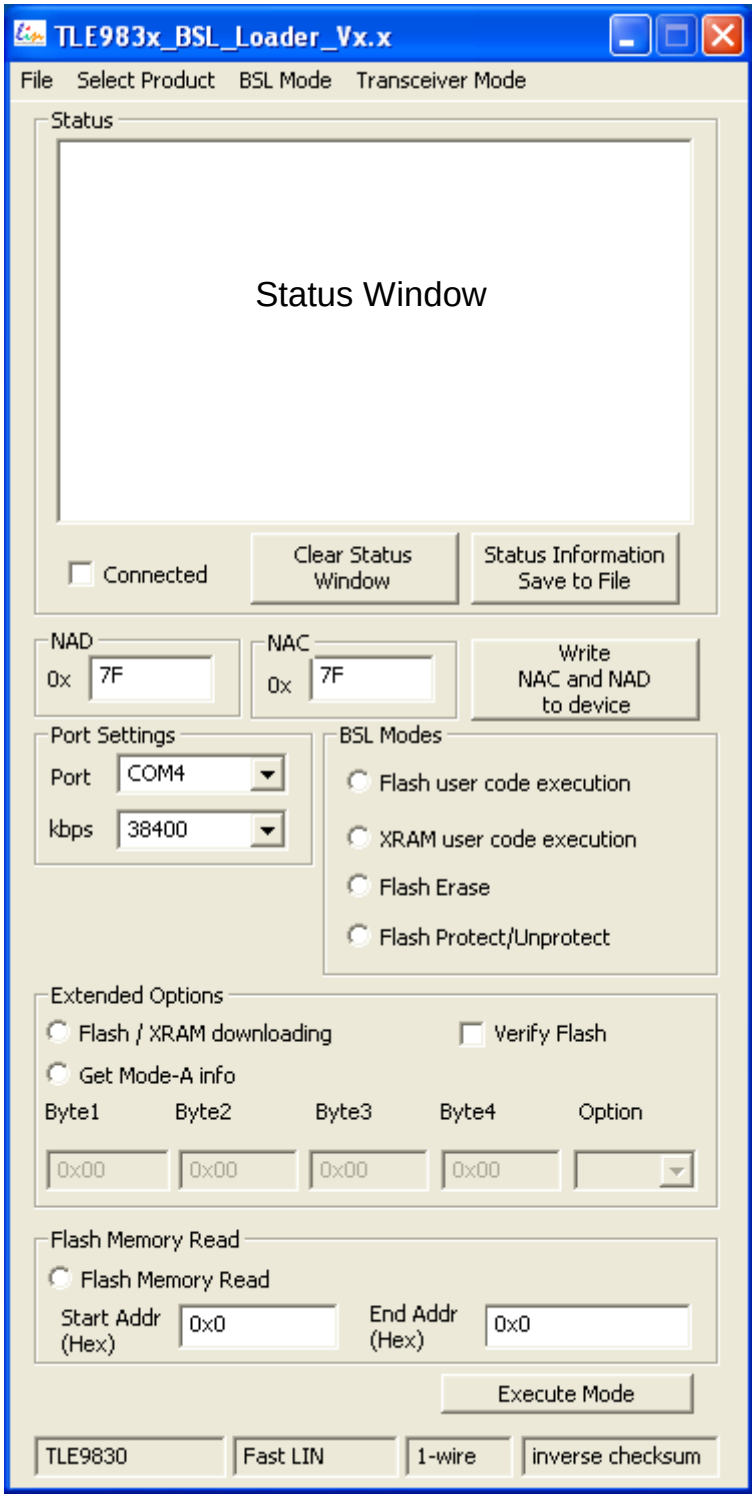

Figure 13 TLE9832_BSL_Loader Main Screen

4.1 Description of Menu Items

4.1.1 File Menu

4.1.1.1 Open

Opens a “File Open Dialog” through which a Hex file can be loaded to download to the device.

4.1.2 Select Product

TLE9830 – Selects TLE9830 device.

TLE9831 – Selects TLE9831 device.

TLE9832 – Selects TLE9832 device.

TLE9833 – Selects TLE9833 device.

TLE9834 – Selects TLE9834 device.

TLE9835 – Selects TLE9835 device.

Note: TLE9832 is selected by default.

4.1.3 BSL Mode

UART BSL – Selects UART BSL Mode of communication

LIN BSL – Selects LIN BSL Mode of communication

DAS – Select DAS Mode of communication

Note: In LIN BSL Mode the Transceiver Mode (see 4.1.4) should be 1 Wire interface. In UART BSL Mode the Transceiver Mode needs to be 2 Wire interface. Transceiver Mode is automatically selected for appropriate BSL mode (UART / LIN).

4.1.3.1 Lin Mode

Normal Lin – Normal Lin Mode is selected.

Fast Lin – Fast Lin Mode is selected.

4.1.3.2 Type of Checksum

The diagnostic LIN frame always uses classic checksum where checksum calculation is over the data bytes only. The checksum is the last field of command and response LIN frames. For TLE983x, there are 2 types of checksum implemented, classic and programming checksum. Both programming and LIN checksum are supported and are indicated in the respective modes.

- Inverse
- Classic

4.1.4 Transceiver Mode

1. Wire [Lin TRx].
2. Wires [UART TRx].

4.1.5 Status Window

Displays all the Events [e.g. Hex file Loaded, Sending UART Frame…].

4.1.6 Clear Status Window

Clears the Status window.

4.1.7 Status information save to file

Stores all the information displayed in the Status Window to a specified file.

Note: TLE983x_BSL_Loader logs all the event information to "TLE983x_log.txt" (x is corresponding device selection).

4.2 BSL Mode Selection

The user can select any one of the following Modes of Operation.

- Mode 0 / 2 / 8: Transfer a user program from the Host to Flash / XRAM
- Mode 1 / 9: Execute a user program in the XRAM
- Mode 3: Execute a user program in the NVM
- Mode 4: Erase NVM Memory (Page wise, Sector wise and Erase Full chip)
- Mode 6: Enable/Disable NVM Protection Mode
- Mode A: Get Mode A Information

4.2.1 Mode 0 / 2 / 8: Transfer a user program from the Host to XRAM

The Mode selection depends on the Hex file which is loaded in the tool.

If the Hex file contains values for Flash location (For TLE9832 device -- 0x0000 to 0x8FFF), then Mode 2 is selected for the transfer of data to the device.

If the Hex file contains values for XRAM location (0xF000 to 0xFBFF) and Inverse checksum is selected (BSL Mode → LIN BSL → Type of Checksum → inverse), then Mode 0 is used internally to transfer data to device.

If the Hex file contains values for XRAM location (0xF000 to 0xFCFF) and classic checksum is selected (BSL Mode → LIN BSL → Type of Checksum → classic), then Mode 8 is used internally to transfer data to device. This Mode is only applicable in LIN BSL.

For the Modes above, the option byte should be zero and the address fields (byte1 and byte2) will be filled from the Hex file while sending the header frame to the device. Therefore, the additional fields (byte1 to byte2) in the GUI should be zero for these Modes.

If the Hex file contains values for XRAM location (0xF000 to 0xFCFF) and the option byte 0xF0 is selected, then the data transfer takes place for writing to CS Page. Byte4 is used to mention CS byte value. This Mode is only applicable in UART & Fast LIN.

The CS byte is used to address the target CS page. This byte contains two information, one in the lower nibble and another one in the upper nibble.

- Upper nibble: it indicates if an OTP or 100TP page is targeted.
- Lower nibble: it indicates which of the 4 possible pages is targeted.

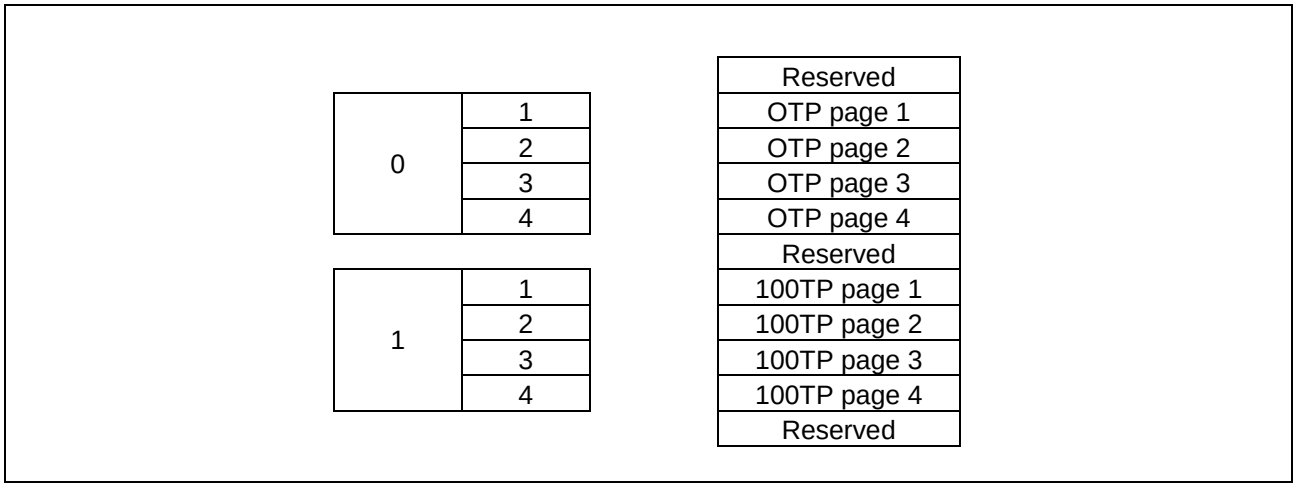

Figure 14 CS Byte values

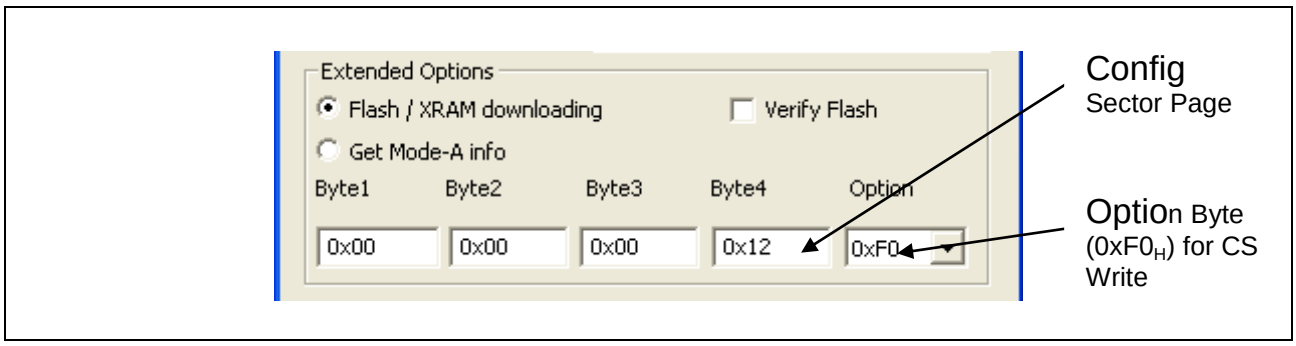

Figure 15 CS page option

4.2.2 Execute a user program in the XRAM

Mode 1 / 9 is used to execute a user program in the XRAM of the device at 0xF000 .

If inverse checksum is selected (Choose BSL Mode → LIN BSL → Type of Checksum → inverse) and executed, then Mode 1 header frame is send to the device for XRAM execution.

If classic checksum is selected (BSL Mode → LIN BSL → Type of Checksum → classic) and executed, then Mode 9 header frame is send to the device for XRAM execution. This Mode is only applicable for LIN BSL.

4.2.3 Execute a user program in the NVM

This option (Mode 3) is used to execute a user program in the Flash of the device at 0x0000 .

4.2.4 Erase NVM memory

If the NVM Erase option is selected, a Flash erase dialog will open with the three options:

1. Flash Page Erase
2. Flash Sector Erase
3. Erase Full chip

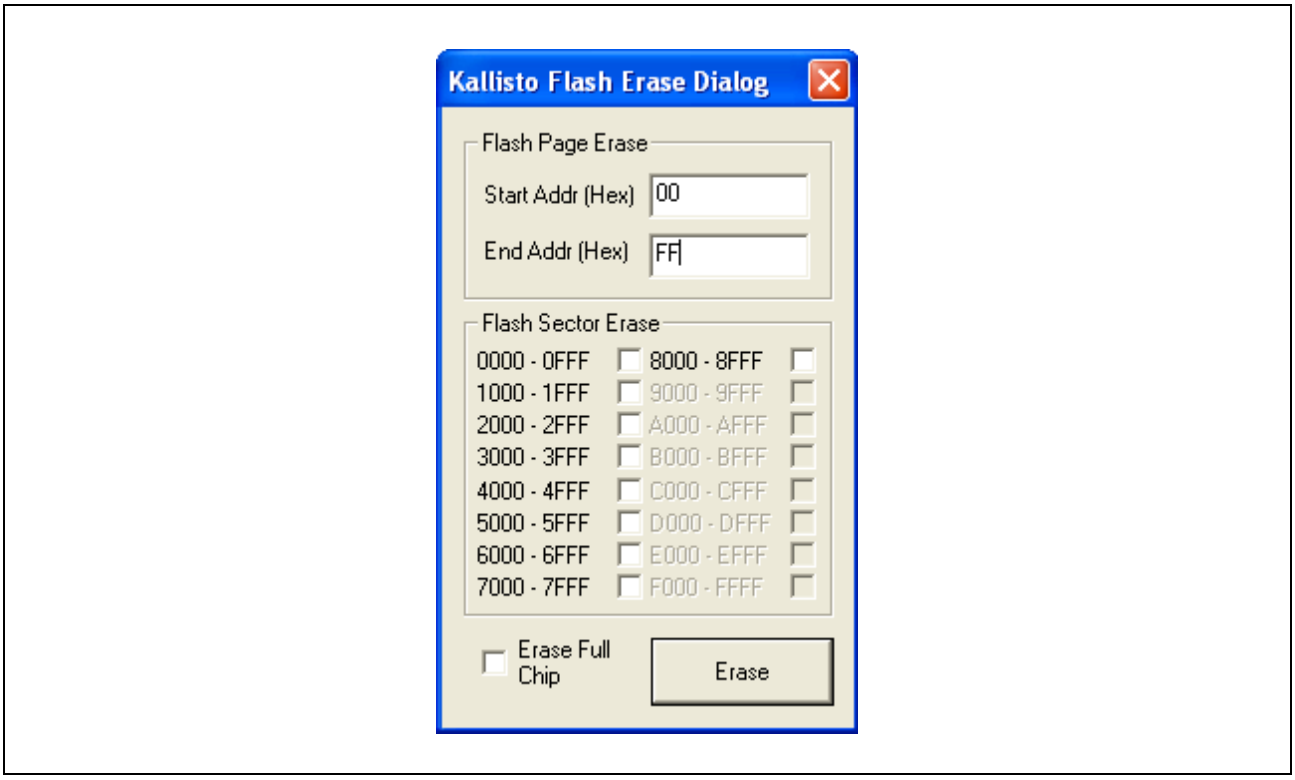

Figure 16 Flash Erase Dialog

The flash page erase option requires a start and end address of the Flash memory to be erased. It will erase flash memory page wise. For example if we mention starting address as 0x00 and address as 0xFF, then Page 0 (0x0000 to 0x007F) and Page1 (0x0080 to 0x00FF) will be erased sequentially.

The flash sector erase option erases the selected address range. All selected sectors will be erased one by one. The flash Erase Full chip option erases the entire flash memory.

4.2.5 NVM Protection Mode enabling / disabling Scheme

Mode 6 is used to enable or disable the NVM Protection Mode through a user password. If the protect/ unprotect option is selected, a flash password protect window will open where the user can enter a password. The password is passed to the Mode 6 Header Frame and enables/disables the NVM Protection Mode. If NVM is already protected, the device will deactivate the NVM Protection Mode when user-password matches the stored NVM_PASSWORD.

Note: When unprotecting the NVM it will be erased.

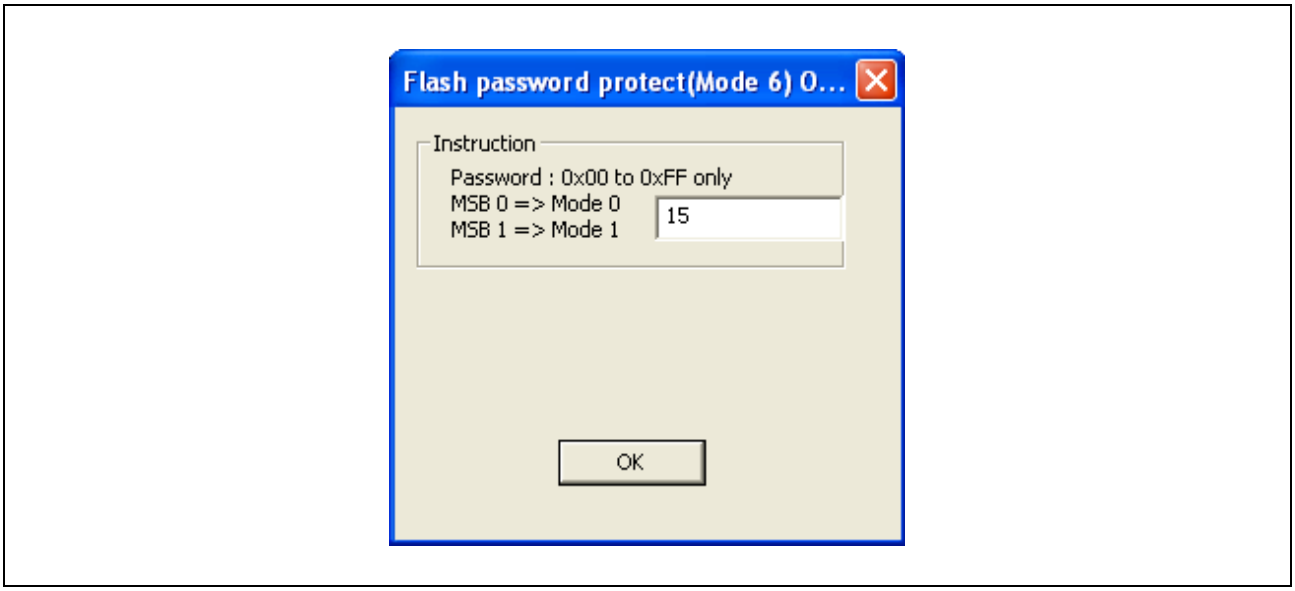

Figure 17 Flash password protect window

Both options (Enable and Disable Flash protect) have the same header. The password is used to protect/unprotect the Flash in Mode 6.

4.2.6 Get Mode A Information

Mode A is used to get distinct information from the device. For more information on Mode A see Section 3.5.1. This mode requires additional data to be sent to the device to distinguish between the various requests. The requests supported under Mode A are described below.

1. Read Device information
2. Verify Flash Page using checksum
3. Verify Entire Flash pages using checksum
4. Verify Configuration Sector using checksum
5. Flash Page Read
6. Config Sector Read

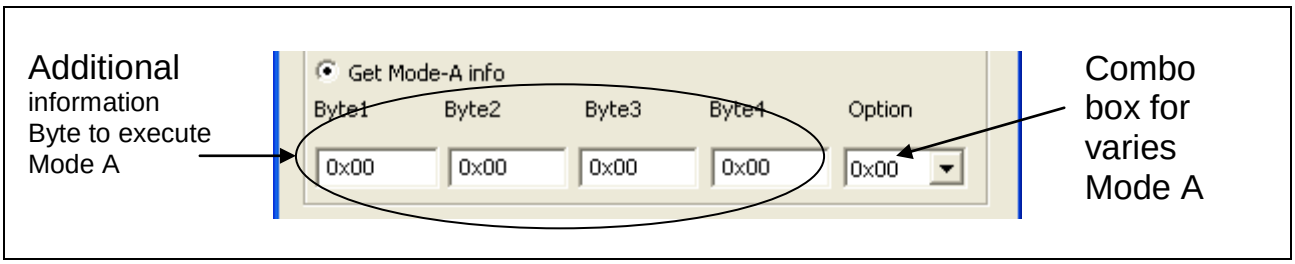

Figure 18 Mode A options

4.2.7 Flash Memory read

This option is customized user selection for “Mode A – Flash page read” BSL Mode. This option reads flash content for specified user Address ranges.

- Start Address – Flash start Address
- End Address – Flash end Address

Note: Flash is always programmed pagewise. Therefore BSL mode reads entire page even though start address & end address not in flash boundary.

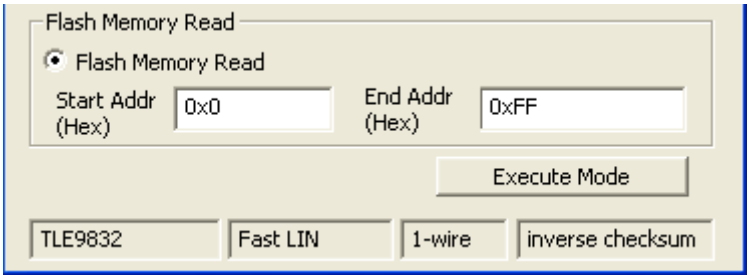

Figure 19 Flash Memory Read

4.2.8 NAD

This field specifies the address of the active slave node. Only slave nodes have an address. The NAD address range supported in TLE983x is listed below:

Table 5 NAD specification

NAD Value	Description
00_H	Invalid Slave Address
$7F_H$	Default Address (NAD value is invalid or it is not programmed in NVM linear area)
01_H to $7E_H$ 80_H to FF_H	Valid Slave Address

4.2.9 NAC

This field specifies the NAC value for TLE device. Refer “2.1 NAC Definition” for the NAC ranges.

4.2.10 Write NAC and NAD to device

This button provides option to write NAC and NAD values to target device.

Note: Flash is always programmed pagewise. Therefore in Normal LIN the entire page (zero filled) will be written if the NAC & NAD values are programmed.

4.2.11 Port Settings

Port – used to select the appropriate COM port for the communication.

Baud Rate – used to specify communication speed.

4.2.12 Status Bar

Displays the current configuration selected by the User.

E.g. selected device, Mode of communication, Transceiver type and checksum type.

4.2.13 Connect to TLE983x

To connect to the device, click on the check*box "Connected"*. After successful connection the box remains "checked". If an attempt to connection has failed the checkbox display changes to "unchecked".

4.2.14 Execute Mode

The button *"Execute Mode"* executes BSL Mode operation depending upon BSL mode selection.

4.3 Sample/Example User configuration:

To load the hex file follow the below procedures:

1. Launch TLE983x_BSL_LOADER
2. Select "File" menu
   File menu pulls down
3. Choose "Open"
   "Open" dialog box appears
4. Select a file to open
5. Click OK.

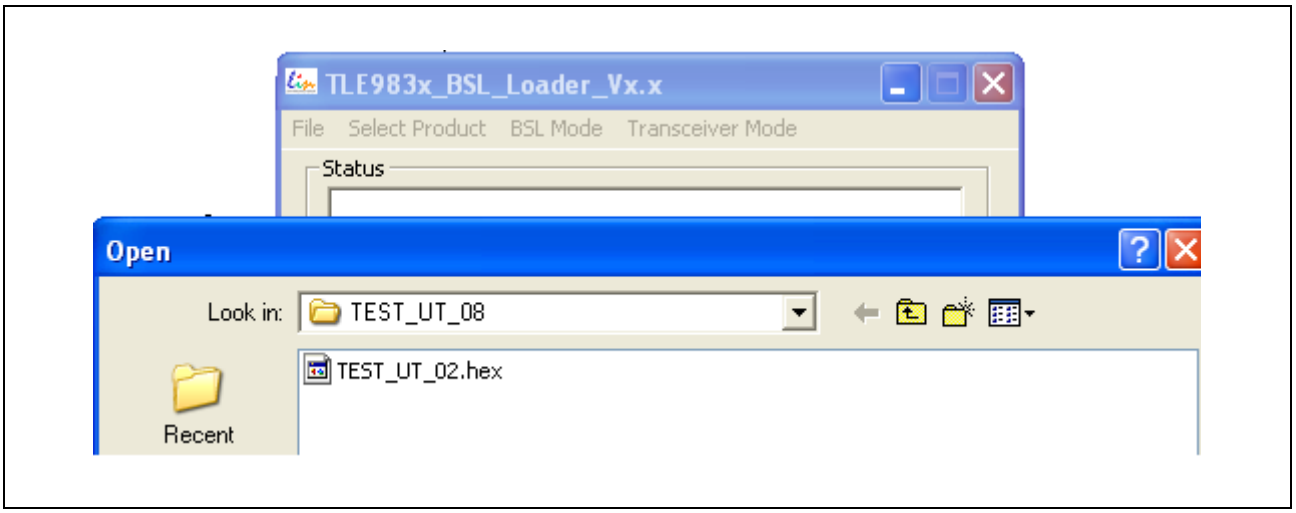

Figure 20 Loading Hex File

6. Select TLE983x Controller from the Select Product Menu.

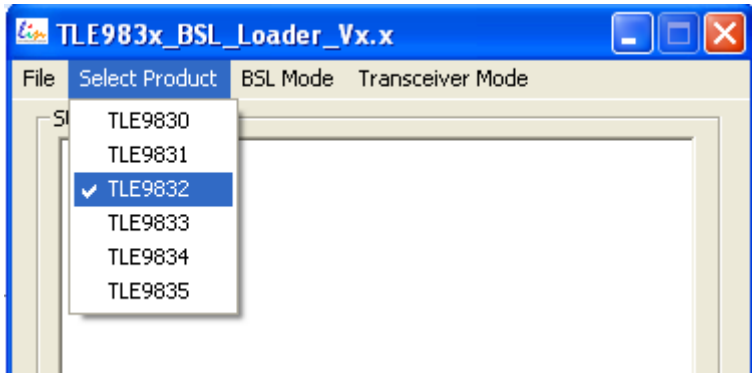

Figure 21 Selecting TLE9832

7. Select UART BSL from the BSL Mode Menu

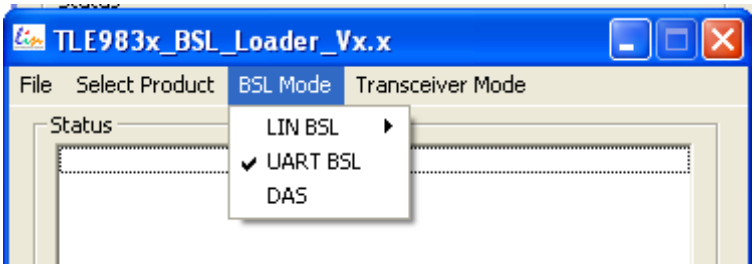

Figure 22 BSL Mode Selection [UART BSL selected]

8. Transceiver mode “2-wire” gets automatically selected.

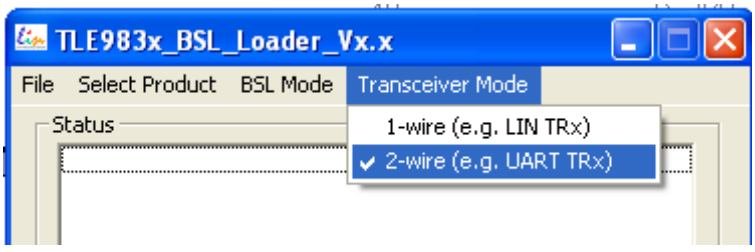

Figure 23 Transceiver Modes

9. For UART BSL, set the NAD value to 0x7F and select appropriate COM Port [e.g., in the figure below COM1 is selected] and set the BAUD rate to 19200 kbps.

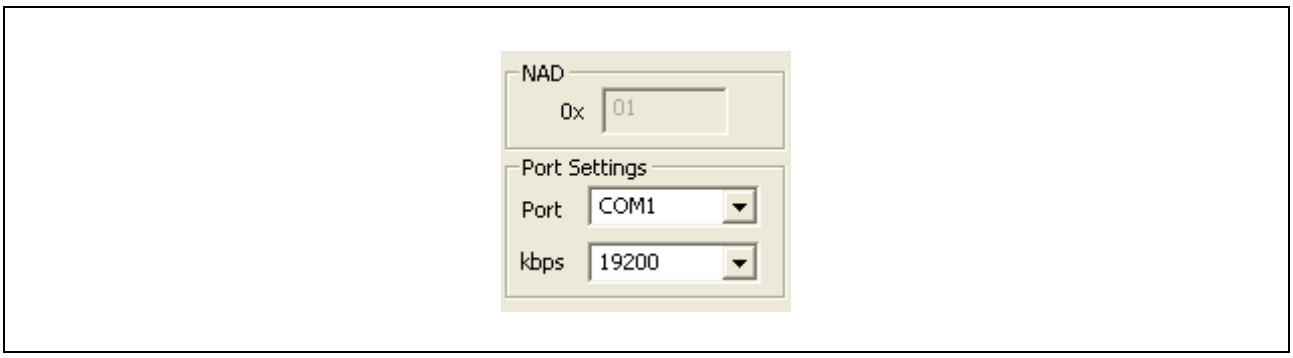

Figure 24 COM Port Settings

10. Now select the desired option out of the BSL Modes for communication:

- e.g. select “Flash / XRAM downloading” or “Get Mode-A info” Mode and the Option (in screenshot 0x00) and click on the “Execute Mode” button.

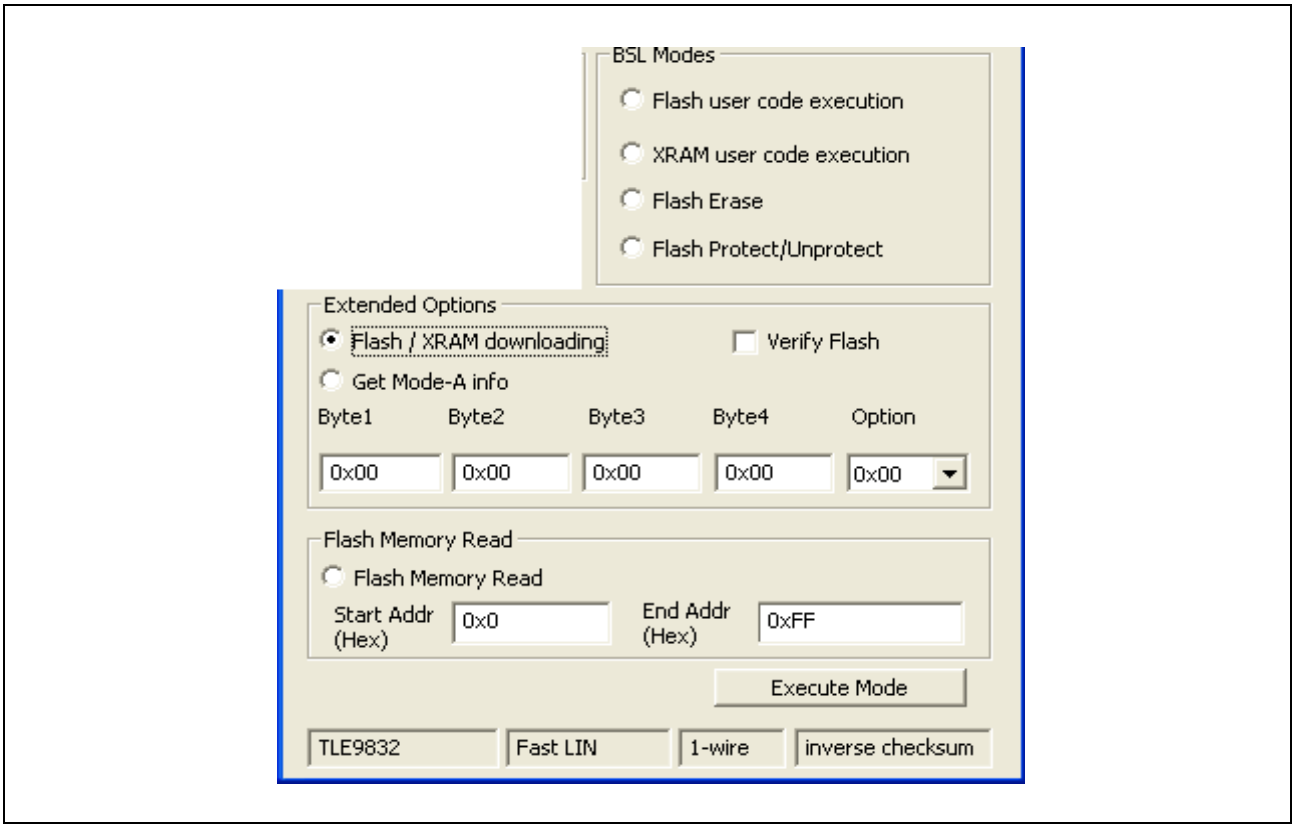

Figure 25 BSL Modes selection

Note: The “Execute Mode” Button must be clicked in order to execute a command. This is applicable for all commands

4.4 Download to or Read from OTP / 100TP CS Page

4.4.1 Creating OTP / 100TP hex file

1. Open Keil µvision IDE to create a new project.
2. Click on the project → New µvision project then enter project name.
3. After providing the project name, Keil opens a device selection window. Select Infineon → TLE9832 (e.g.) controller.
4. There is no need to add any startup file for this project.
5. On the tool bar select File → New. A new file for editing will be created.
6. The following table shows the XRAM location values.
   For the offset selection of the corresponding XSFR, see TLE983x_BootROM Document.

Table 6 OTP / 100TP File Structure

XRAM	Function
$F000_H$	Number of bytes to be programmed
$F001_H$	OTP / 100TP offset 1
$F002_H$	OTP / 100TP data byte 1 to be programmed
$F003_H$	OTP / 100TP offset 2
$F004_H$	OTP / 100TP data byte 2 to be programmed
.....	....
$F001_H$ + ((N-1) x 2)	OTP / 100TP offset N
$F002_H$ + ((N-1) x 2)	OTP / 100TP data byte N to be programmed

Example:

The following example shows how to write 7 bytes to the starting address 0xF001.

Table 7 Sample OTP / 100TP File Structure

XRAM	Value
$F000_H$	0x07
$F001_H$	0xAA
$F002_H$	0xBB
$F003_H$	0xCC
$F004_H$	0xDD
$F005_H$	0xEE
$F006_H$	0xFF
$F007_H$	0xAB

Code Listing 1 OTP/100TP-A51 File

```
001:    CSEG    AT       0xF000
002:    DB   0x07    // Number of bytes to be programmed
003:    DB   0x00    // OTP / 100TP offset 1
004:    DB   0xAA    // OTP / 100TP data 1 to be programmed
005:    DB   0x01    // OTP / 100TP offset 2
006:    DB   0xBB    // OTP / 100TP data 2 to be programmed
007:    DB   0x02    // OTP / 100TP offset 3
008:    DB   0xCC    // OTP / 100TP data 3 to be programmed
009:    DB   0x03    // OTP / 100TP offset 4
010:    DB   0xDD    // OTP / 100TP data 4 to be programmed
011:    DB   0x04    // OTP / 100TP offset 5
012:    DB   0xEE    // OTP / 100TP data 5 to be programmed
013:    DB   0x05    // OTP / 100TP offset 6
014:    DB   0xFF    // OTP / 100TP data 6 to be programmed
015:    DB   0x06    // OTP / 100TP offset 7
016:    DB   0xAB    // OTP / 100TP data 7 to be programmed
017:    END
```

Copy the above code lines to the new file which was opened in step 5 and

7. Save the file to <file>.A51. And then Add <file>.A51 to the opened project.
   Right click on “Source Group 1” which is available in the project window.
   In the popup menu click on “Add Files to Group “Source Group 1”…”. It will open a file dialog; Select <file>.A51 to add to the project.
8. Click on the tool bar → Project → Option for Target.
   In the Output tab, select “Create Hex File” checkbox.
9. Generate Hex file.
   Click on tool bar → Project → Build Target.

4.4.2 Downloading OTP / 100TP CS page

1. Launch TLE983x_BSL_LOADER
2. Select "File" menu
3. Choose "Open"
4. Select a file to open
5. Click Ok
6. Select UART BSL or Fast BSL from BSL Mode Menu
7. Select 2-wire from Transceiver Mode Menu if UART BSL is selected
8. Select 1-wire from Transceiver Mode Menu if Fast LIN BSL is selected
9. For Fast LIN BSL set the appropriate NAD value for the device, as well as the appropriate NAC value for the Fast LIN BSL or UART BSL Mode
10. Select the appropriate COM Port and BAUD rate
11. Select the “Flash / XRAM downloading” option button
12. See Figure 14 for the appropriate OTP / 100TP selection.
    For example; If we write 100TP page 2, then Byte 4 field filled with “0x12”
13. Select Option byte as 0xF0 from Combo box
14. Click “Execute Mode” Button for download to device.

Note: If OTP is already written, then the BSL Loader returns Protection error while downloading. If 100TP is already written 100 times then BSL Loader will return a Protection error while downloading. If Invalid address is given in byte-4 field then BSL Loader returns Block_type error while downloading.

4.4.3 Read OTP / 100TP CS page

1. After successfully downloaded to OTP / 100TP
   Select “Get Mode A info” option button
2. See Figure 14 for appropriate OTP / 100TP selection
   For example, if we verify 100TP page 2, then Byte 4 field filled with “0x12”
3. Select Option byte as 0xF0 from Combo box
4. Click “Execute Mode” Button
5. The status Window will show 128 bytes of the OTP / 100TP CS Page values.
   In this example the first 7 bytes should show as “0xAA 0xBB 0xCC 0xDD 0xEE 0xFF 0xAB”

5 Command Line Argument

TLE983x_BSL_Loader supports command line arguments for accessing Bootstrap Loader functions. The command line menu is displayed below. It is broken down into two parts; Commands, and Options (for DL command and EX command).

```
/*************************************************************************/
*** Commands:
 Show Help Menu:        -H
 Show Examples:         -EG
 Show Current Settings: -SC
 Download Hex File:     -DL <FileName> + DL Options
 Execute command:       -EX + EX Options

 ** DL Options:
 -M      <Execution Number> = Code execution start location
          0 = FLASH     1 = XRAM
 -PW     <1 byte Hex value> = Protect device with 1 byte Hex Number


** EX Options:
 -M      <Execution Number> = Code execution start location
          0 = FLASH     1 = XRAM
 -PW     <1 byte Hex value> = Protect device with 1 byte Hex Number

** Additional Option applicable to all commands:
 -SM     = Message Box will be displayed for Status instead of command line output.
```

The command line feature also takes inputs from TLE983x_BSL_Loader. Therefore the user needs to either configure TLE983x_BSL_Loader (GUI) with the required settings and close the GUI or edit the file “default.ini” before invoking a command.

The following inputs are coming from TLE983x_BSL_Loader:
1. BSL Mode
2. Type of Checksum
3. Transceiver Mode
4. COM Port
5. Baud Rate
6. Verify Programmed Flash
7. NAD

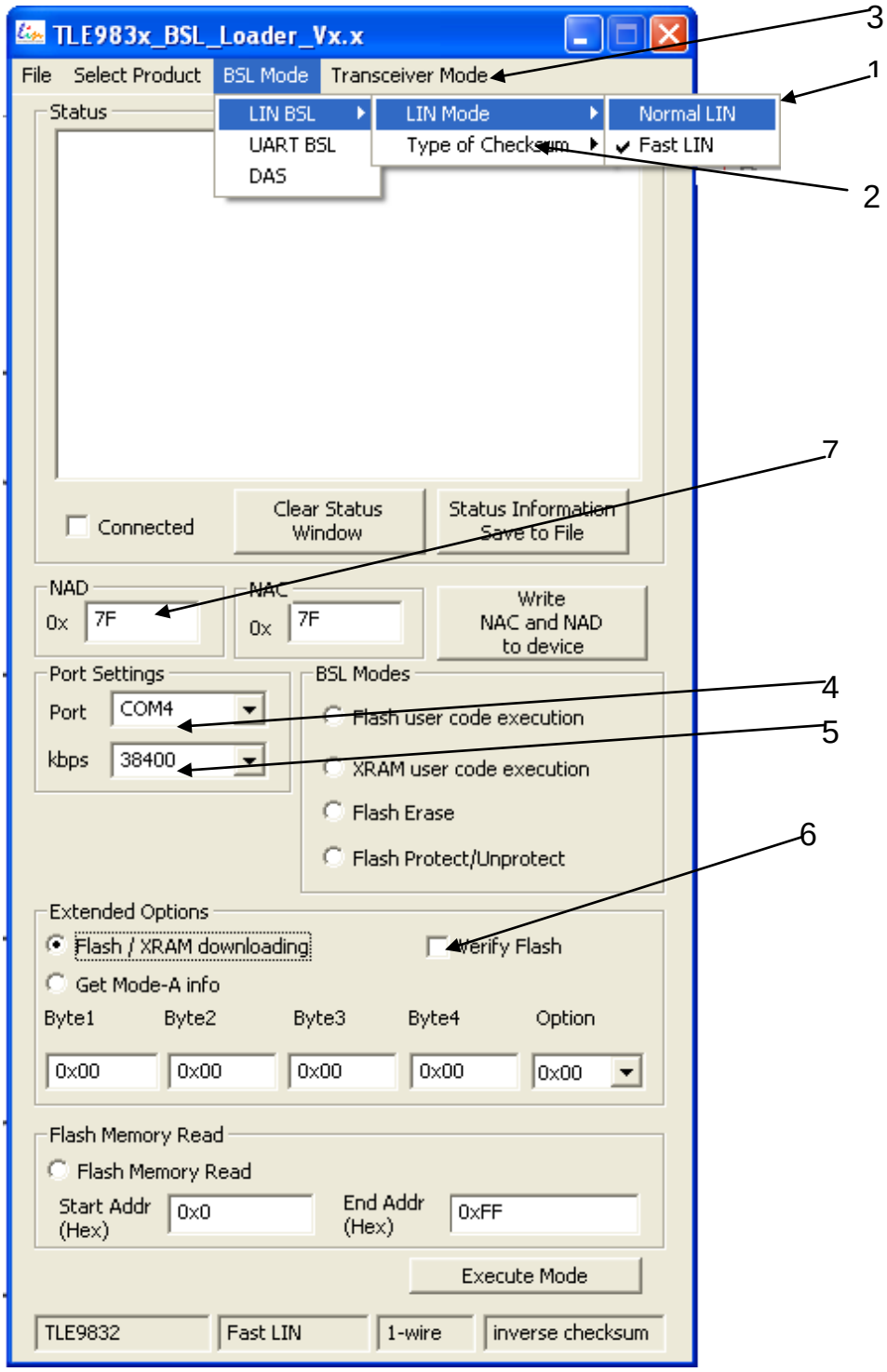

Figure 26 BSL_Loader Main Page selection

5.1 Edit default.ini file

Edit the file “default.ini” to configure TLE983x_BSL_Loader for command line execution.

Default.ini file structure:

[default setting]

NAD=xx	: This field represents the Node Address. "xx” specifies Node Address
product_name=Kallisto	: It is always “Kallisto”
product_code=TLE9832	: Default is “TLE9832”
default_commport=COMx	: This field represents the Com Port. "x” specifies port number
default_BSL=LIN	: This field represents the BSL Mode. Available options are LIN / UART / Fast LIN / DAS
transceiver=1-wire	: This field represents the Transceiver Mode. Available options are 1-wire (LIN TRx) and2-wire (UART TRx)
checksum=inverse	: This field represents the CheckSum option for LIN BSL. Available options are inverse and classic
default_baudrate=9600	: This field represents the Baudrate. Available options are 1200, 2400, 4800, 9600, 19200, 38400, 57600 and 115200
Verify_Flash=0	: If this value is 1 then the BSL Loader verifies flash content after hex file downloaded to flash, If this value is 0 then the BSL_Loader not verifies flash content

Note: If any values are invalid, TLE983x_BSL_Loader will take default values.

Before executing command line options the TLE983x_BSL_Loader (GUI) must be closed.

5.2 Commands

There are five commands available. Only one command will be accepted at a time.

- **Show Help Menu: TLE983x_BSL_Loader –H**

After the menu is triggered for the first time, it is saved *as hlpcmdline.txt* in the working folder for TLE983x_BSL_Loader.

- **Show Examples: TLE983x_BSL_Loader –EG**

After the menu is triggered for the first time, it is saved as *egcmdline.txt* in the working folder for TLE983x_BSL_Loader. The menu will display several examples on the usage of the commands and options.

- **Show Current Settings: TLE983X_BSL_LOADER –SC**

The menu will display the current settings of the loader. This will help the users to decide on the required options. The settings can be changed in the TLE983X_BSL_LOADER program (GUI) or by editing the file “*default.ini*”.

- **Download Hex File: TLE983X_BSL_LOADER –DL <FileName> + DL Options**

This command is used for downloading a hex file to the target device. The command works with several options that are explained in the next section.

- **Execute a command: TLE983X_BSL_LOADER –Ex + Ex Options**

This command is used for execution of a code and writing a password. The command works with several options that are explained in the next section.

5.2.1 Option

The following options are available with the tools command line interface:

- **-M <Execution Number> (available for both DL and EX commands)**

Execute the code in the Flash (0) or XRAM (1) after downloading a hex file.

E.g. TLE983X_BSL_LOADER –DL hexfile.hex –M 1
Download hexfile.hex to the device and then execute from XRAM.

- **-PW <1/2 byte(s) Hex value> (available for both DL and EX commands)**

This option is used to protect the flash with a 1 byte Hex password after downloading of the code.

E.g. TLE983X_BSL_LOADER –DL hexfile.hex –PW 22
Download hexfile.hex to TLE983x device and protect it with 0x22.

- **-SM (available for all the commands)**

This option is used for displaying the status messages in a pop up window instead of a command line output.

The status messages for the –DL and –EX options are displayed in the command shell and as well saved in the file. "*cmdline.txt"*.

E.g. TLE983X_BSL_LOADER –DL hexfile.hex -SM

6 Assumptions and Limitations

- The user is experienced to work with the TLE983x devices.
- Only hex files are supported for the download through this tool.
- The tool requires 30 *ms* to initiate the first communication. Therefore the user must set the appropriate NAC value (0x07 or higher).
  Best choice for NAC Value:
  - $0D_H$ - $7F_H$, 00_H, invalid (wait forever for the first LIN frame)
  - $8D_H$ - FF_H, 80_H (wait forever for the first UART frame).
- Normal LIN supports 9.6kBit/s and 19.2kBit/s.
- Fast LIN supports 9.6kBit/s, 19.2kBit/s, 38.4kBit/s, 57.6kBit/s and 115.2kBit/s.

w w w . i n f i n e o n . c o m

Published by Infineon Technologies AG